

CLAIMS

I claim:

- 1 1. A loudspeaker motor structure comprising:
  - 2 a magnetic pole piece comprising a first end elongated along an axis and a second
  - 3 end;
  - 4 a magnetic structure comprising:
    - 5 a magnet comprising a first magnetic pole and a second magnetic pole, the second
    - 6 magnetic pole being magnetically coupled to the second end of the pole piece, and
    - 7 portions defining an opening along the axis, the first end of the pole piece being
    - 8 positioned in the opening of the magnetic structure to form a gap between the first
    - 9 end of the pole piece and the portions defining the opening of the magnetic structure
    - 10 proximate to the first end of the pole piece, the portions defining the opening that are
    - 11 proximate the first end of the pole piece being magnetically coupled to the first
    - 12 magnetic pole, resulting in a magnetic field in the gap; and
    - 13 a voice coil sliding on the first end of the pole piece along the axis in the gap;
  - 14 wherein:
    - 15 the pole piece and the portions defining the opening of the magnetic structure
    - 16 proximate to the first end of the pole piece are capable of being rotated relative each other
    - 17 around the axis under predetermined conditions; and
    - 18 the magnetic field in the gap varies with rotation of the pole piece and the portions
    - 19 defining the opening of the magnetic structure proximate to the first end of the pole piece
    - 20 relative each other around the axis.
- 1 2. A loudspeaker motor structure according to claim 1, further comprising a diaphragm
- 2 and a spider, wherein:
  - 3 the voice coil comprises a former and wire windings capable of receiving driving
  - 4 current, the voice coil being subjected to an electromotive force generated by interaction
  - 5 of the driving current and the magnetic field in the gap;
  - 6 the former of the voice coil is coupled to the spider; and

7 the former of the voice coil is coupled to the diaphragm to move the diaphragm  
8 when the voice coil slides on the first end of the pole piece in response to the  
9 electromotive force.

1 3. A motor structure according to claim 2, wherein:

2 the second end of the pole piece comprises a base having a diameter larger than  
3 diameter of the first end of the pole piece;

4 the magnetic structure further comprises:

5 an upper back plate comprising a first and second upper back plate surfaces  
6 normal to the axis, and portions defining an upper back plate opening between the  
7 first and second upper back plate surfaces, the upper back plate opening having a first  
8 dimension near the first upper back plate surface and a second dimension near the  
9 second upper back plate surface, the first dimension being smaller than the second  
10 dimension, the first dimension being smaller than the diameter of the base; and

11 a lower back plate comprising a first lower back plate surface and a second lower  
12 back plate surface opposite the first lower back plate surface, the first lower back  
13 plate surface being attached by to the second upper back plate surface to form a  
14 chamber defined by the first lower back plate surface and the portions of the upper  
15 back plate that define the opening near the second upper back plate surface;

16 wherein the base of the pole piece is positioned in the chamber so that the pole piece  
17 is capable of being rotated around the axis when the lower back plate is loosely  
18 attached to the upper back plate.

1 4. A motor structure according to claim 3, wherein:

2 the first end of the pole piece is substantially cylindrical having a periphery, the first  
3 end of the pole piece comprising portions defining at least one pole piece irregularity on  
4 the periphery; and

5 the opening of the magnetic structure proximate to the first end of the pole piece is  
6 substantially round with at least one magnetic structure irregularity.

1 5. A motor structure according to claim 4, wherein the pole piece further comprises  
2 portions defining a center bore extending from the first end to the second end, and the  
3 lower back plate further comprises portions defining a center opening extending from the  
4 first lower back plate surface to the second lower back plate surface, whereby air flows  
5 through the center bore of the pole piece and the center opening of the lower back plate.

1 6. A motor structure according to claim 5, further comprising bolts attaching the lower  
2 back plate to the upper back plate.

1 7. A motor structure according to claim 4, wherein:  
2 the at least one pole piece irregularity comprises a plurality of pole piece  
3 irregularities evenly spaced on the periphery; and  
4 the at least one magnetic structure irregularity comprises a plurality of magnetic  
5 structure irregularities evenly spaced on the portions defining the opening of the magnetic  
6 structure proximate the first end of the pole piece.

1 8. A motor structure according to claim 7, wherein the pole piece further comprises  
2 portions defining a center bore from the first end to the second end, and the lower back  
3 plate further comprises portions defining a center opening from the first lower back plate  
4 surface to the second lower back plate surface, whereby air flows through the center bore  
5 of the pole piece and the center opening of the lower back plate.

1 9. A loudspeaker motor structure comprising:  
2 a pole piece comprising a top end and a base, the top end comprising cylindrical walls  
3 elongated along a center line axis, the walls comprising at least one pole piece  
4 irregularity, the base having a base diameter larger than diameter of the top end;  
5 a magnet comprising first and second magnet surfaces normal to the axis, and  
6 portions defining a magnet opening extending along the axis;  
7 a front plate comprising first and second front plate surfaces normal to the axis, and  
8 portions defining a front plate opening with at least one front plate irregularity, the  
9 second front plate surface being attached to the first magnet surface;

an upper back plate comprising first and second upper back plate surfaces normal to the axis, and portions defining an upper back plate opening extending along the axis between the first and second upper back plate surfaces, the upper back plate opening comprising a first space with a first dimension near the first upper back plate surface and a second space with a second dimension near the second upper back plate surface, the first dimension being smaller than the second dimension, the first dimension being smaller than the base diameter, the first upper back plate surface being attached to the second magnet surface;

a lower back plate attached to the second upper back plate surface; and

a voice coil sliding on the top end of the pole piece;

wherein the base is positioned in the second space, the top end is positioned in the front plate opening to form a gap between the top end and the front plate, magnetic field extending through the gap, the lower and upper back plates are capable of loose and tight attachment, the pole piece being capable of rotation around the axis relative to the front plate to change strength of the magnetic field when the upper and lower back plates are loosely attached to each other.

10. A motor structure according to claim 9, further comprising a diaphragm and a spider, wherein:

the voice coil comprises a former and wire windings capable of receiving driving current, the voice coil being subjected to an electromotive force generated by interaction of the driving current and the magnetic field in the gap;

the former of the voice coil is coupled to the spider; and

the former of the voice coil is coupled to the diaphragm to move the diaphragm when the voice coil slides on the top end of the pole piece in response to the electromotive force.

11. A motor structure according to claim 10, further comprising bolts attaching the lower back plate to the upper back plate.

12. A motor structure according to claim 11, wherein:

2 the pole piece further comprises portions defining a center bore from the top end to  
3 the base; and

4 the lower back plate further comprises first and second lower back plate surfaces  
5 normal to the axis, and portions defining a lower back plate opening between the first and  
6 second lower back plate surfaces;

7 whereby air flows through the center bore and the lower back plate opening.

1 13. A motor structure according to claim 12, wherein:

2 the at least one pole piece irregularity comprises a plurality of evenly spaced pole  
3 piece irregularities; and

4 the at least one front plate irregularity comprises a plurality of evenly spaced front  
5 plate irregularities.

1 14. A motor structure according to claim 13, wherein:

2 the plurality of pole piece irregularities comprises a plurality of slots; and

3 the plurality of front plate irregularities comprises a plurality of notches.

1 15. A loudspeaker comprising:

2 a basket;

3 a diaphragm;

4 a spider attached to the basket;

5 a pole piece comprising a top end and a base, the top end comprising cylindrical walls  
6 elongated along a center line axis, the walls comprising at least one pole piece  
7 irregularity, the base having a base diameter larger than diameter of the top end;

8 an annular magnet comprising first and second magnet surfaces normal to the axis,  
9 and portions defining a magnet opening extending along the axis;

10 a front plate attached to the basket, the front plate comprising first and second front  
11 plate surfaces normal to the axis, and portions defining a front plate opening with at least  
12 one front plate irregularity, the second front plate surface being attached to the first  
13 magnet surface;

14 an upper back plate comprising first and second upper back plate surfaces normal to  
15 the axis, and portions defining an upper back plate opening extending along the axis  
16 between the first and second upper back plate surfaces, the upper back plate opening  
17 comprising a first space with a first diameter near the first upper back plate surface and a  
18 second space with a second dimension near the second upper back plate surface, the first  
19 dimension being smaller than the second dimension, the first dimension being smaller  
20 than the base diameter, the first upper back plate surface being attached to the second  
21 magnet surface;

22 a lower back plate attached to the second upper back plate surface; and

23 a voice coil comprising a former and wire windings capable of receiving driving  
24 current, the former being attached to the spider and to the diaphragm;  
25 wherein:

26 the base is positioned in the second space, the top end is positioned in the front plate  
27 opening to form a gap between the top end and the front plate, magnetic field extends  
28 through the gap, the lower and upper back plates are capable of loose and tight  
29 attachment, the pole piece is capable of rotation around the axis relative to the front plate  
30 to change strength of the magnetic field when the upper and lower back plates are loosely  
31 attached to each other; and

32 the voice coil slides on the top end to drive the diaphragm under influence of an  
33 electromotive force resulting from interaction of the magnetic field and the driving  
34 current.

1 16. A loudspeaker according to claim 15, wherein:

2 the at least one pole piece irregularity comprises a plurality of evenly spaced pole  
3 piece irregularities; and

4 the at least one front plate irregularity comprises a plurality of evenly spaced front  
5 plate irregularities.

1 17. A loudspeaker motor structure comprising:

2 a magnetic pole piece comprising a bottom end and a top end elongated along an axis;

3 a magnetic structure comprising:

4 a magnet comprising a first magnetic pole and a second magnetic pole, and  
5 portions defining a first opening extending along the axis, the first end being  
6 positioned in the first opening to form a first gap between the first end and the  
7 portions defining the first opening, the portions defining the first opening being  
8 magnetically coupled to the first magnetic pole;  
9 a magnetic back plate comprising threaded portions defining a second opening  
10 concentric with the axis, the back plate being magnetically coupled to the second  
11 magnetic pole;  
12 a non-magnetic center thread component attached to the second end, the center thread  
13 component having a threaded jutting part positioned in the second opening and engaging  
14 the threaded portions so that rotation of the center thread component relative to the back  
15 plate moves the center thread component and the pole piece along the axis in relation to  
16 the back plate, varying a second gap between the back plate and the pole piece, thereby  
17 varying magnetic coupling between the pole piece and the back plate, and thereby  
18 varying magnetic field in the first gap; and  
19 a voice coil comprising a former and wire windings capable of receiving electric  
20 current, the voice coil sliding on the top end under influence of an electromotive force  
21 generated by interaction of the magnetic field in the first gap and the electric current.

1 18. A motor structure according to claim 17, further comprising at least one locknut  
2 positioned on the threaded jutting part of the center thread component to prevent the  
3 center thread component from rotating relative to the back plate when the at least one  
4 locknut is tightened against the back plate.

1 19. A motor structure according to claim 18, further comprising a heat-conducting non-  
2 magnetic sleeve having a base and a side wall surrounding a sleeve center opening, the  
3 side wall being positioned to receive the pole piece and allow the pole piece to slide  
4 along the axis inside the side wall substantially in contact with the pole piece, the base of  
5 the sleeve being attached to the back plate, whereby the sleeve facilitates heat transfer  
6 between the pole piece and the back plate.

1 20. A loudspeaker motor structure according to claim 19, further comprising a  
2 diaphragm and a spider, wherein:  
3 the former of the voice coil is coupled to the spider; and  
4 the former of the voice coil is coupled to the diaphragm to move the diaphragm when  
5 the voice coil slides on the first end of the pole piece in response to the electromotive  
6 force.

1 21. A loudspeaker motor structure comprising:  
2 a magnetic pole piece comprising a cylindrical top end elongated along a center line  
3 axis, and a bottom end comprising portions defining an aperture extending along the axis;  
4 a magnet comprising first and second magnet surfaces normal to the axis;  
5 a magnetic front plate comprising first and second front plate surfaces normal to the  
6 axis, and portions defining a front plate opening between the first and second front plate  
7 surfaces, the second front plate surface being attached to the first magnet surface;  
8 a magnetic back plate comprising first and second back plate surfaces normal to the  
9 axis, and portions defining a back plate opening between the first and second back plate  
10 surfaces, the portions defining the back plate opening comprising portions defining a first  
11 space with a first dimension near the first back plate surface and threaded portions  
12 defining a second space with a second diameter near the second back plate surface;  
13 a non-magnetic center thread component comprising an inner part positioned in the  
14 aperture and a jutting part protruding from the aperture, the jutting part being threaded  
15 into the second space so that the top end is positioned in the front plate opening to form a  
16 gap between the pole piece and the front plate; and  
17 a voice coil sliding on the top end;  
18 wherein magnetic field extends through the gap, strength of the magnetic field increases  
19 when the pole piece is turned in a first direction to bring the pole piece towards the back  
20 plate, the strength of the magnetic field decreases when the pole piece is turned in a  
21 second direction to take the pole piece away from the back plate.

1 22. A motor structure according to claim 21, wherein the first dimension is larger than  
2 the second dimension, the motor structure further comprising a heat-conducting non-



3 magnetic sleeve having a base and a side wall surrounding a sleeve center opening, the  
4 side wall being capable of receiving the pole piece and allowing the pole piece to slide  
5 inside the side wall substantially in contact with the pole piece, the base of the sleeve  
6 being attached to the back plate, whereby the sleeve facilitates heat transfer between the  
7 pole piece and the back plate.

1 23. A motor structure according to claim 22, wherein the side wall is cylindrical having  
2 an outside diameter substantially equal to outside diameter of the top end of the pole  
3 piece, and an inside diameter substantially equal to a diameter of the bottom end.

1 24. A motor structure according to claim 23, further comprising a diaphragm and a  
2 spider, wherein:

3 the voice coil comprises a former and wire windings capable of receiving driving  
4 current, the voice coil being subjected to an electromotive force generated by interaction  
5 of the driving current and the magnetic field in the gap;

6 the former of the voice coil is coupled to the spider; and

7 the former of the voice coil is coupled to the diaphragm to move the diaphragm  
8 when the voice coil slides on the top end of the pole piece in response to the  
9 electromotive force.

1 25. A motor structure according to claim 24, wherein:

2 the pole piece further comprises portions defining a first through bore from the top  
3 end to the aperture; and

4 the center thread component further comprises portions defining a second through  
5 bore extending along the axis;

6 whereby air flows through the first and second through bores.

1 26. A motor structure according to claim 21, further comprising at least one locknut  
2 positioned on the jutting part of the center thread component to prevent the center thread  
3 component from rotating relative to the back plate when the at least one locknut is  
4 tightened against the back plate.

1 27. A loudspeaker comprising:

2 a basket;

3 a diaphragm;

4 a spider attached to the basket;

5 a magnetic pole piece comprising a cylindrical top end elongated along a center line  
6 axis, and a bottom end comprising portions defining an aperture extending along the axis;

7 a magnet comprising first and second magnet surfaces normal to the axis;

8 a magnetic front plate attached to the frame, the front plate comprising first and  
9 second front plate surfaces normal to the axis, and portions defining a front plate opening  
10 between the first and second front plate surfaces, the second front plate surface being  
11 attached to the first magnet surface;

12 a magnetic back plate comprising first and second back plate surfaces normal to the  
13 axis, and portions defining a back plate opening between the first and second back plate  
14 surfaces, the portions defining the back plate opening comprising portions defining a first  
15 space with a first dimension near the first back plate surface and threaded portions  
16 defining a second space with a second diameter near the second back plate surface;

17 a non-magnetic center thread component comprising an inner part positioned in the  
18 aperture and a jutting part protruding from the aperture, the jutting part being threaded  
19 into the second space so that the top end is positioned in the front plate opening to form a  
20 gap between the pole piece and the front plate; and

21 a voice coil sliding on the top end, the voice coil comprising a former attached to the  
22 spider and to the diaphragm, the voice coil further comprising wire windings capable of  
23 receiving driving current;

24 wherein:

25 magnetic field extends through the gap, strength of the magnetic field increases  
26 when the pole piece is turned in a first direction to bring the pole piece towards the back  
27 plate, the strength of the magnetic field decreases when the pole piece is turned in a  
28 second direction to take the pole piece away from the back plate; and

29 the voice coil is positioned in the gap and moved by an electromotive force  
30 generated by interaction of the driving current and the magnetic field in the gap.

- 1 28. A loudspeaker motor structure comprising:  
2 a magnetic pole piece comprising a first end and a second end;  
3 a magnetic structure comprising:  
4 a magnet with a first and second magnetic poles,  
5 means for magnetically coupling the second magnetic pole to the second end of  
6 the pole piece, and  
7 portions defining an opening, the first end of the pole piece being disposed in the  
8 opening to form a gap between the first end and the portions defining the opening, the  
9 portions defining the opening being magnetically coupled to the first magnetic pole,  
10 thereby creating a magnetic field in the gap;  
11 means for moving the pole piece to adjust strength of the magnetic field in the gap;  
12 and  
13 a voice coil sliding on the first end, the voice coil comprising a former and wire  
14 windings capable of receiving driving current, the voice coil being influenced by an  
15 electromotive force generated by interaction of the driving current and the magnetic field  
16 in the gap.